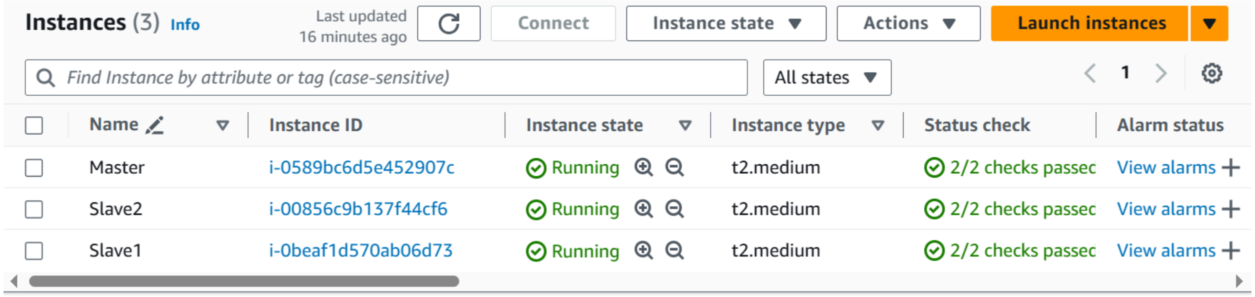
Name: Mohit Kerkar Div: D15C Roll No: 23

Adv DevOps Lab Exp 03

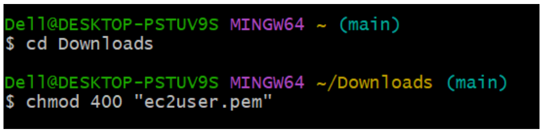
Aim: To understand the Kubernetes Cluster Architecture, install and Spin Up aKubernetes Cluster on Linux Machines/Cloud

Step 1: Create 3 EC2 instances (1 master and 2 slaves). Select SSH option in the inbound rules. Created a key pair to be used commonly between all 3 instances created.
I selected AWS Linux as my operating system and enabled **t2 medium** option for kubernetes cluster to run smoothly

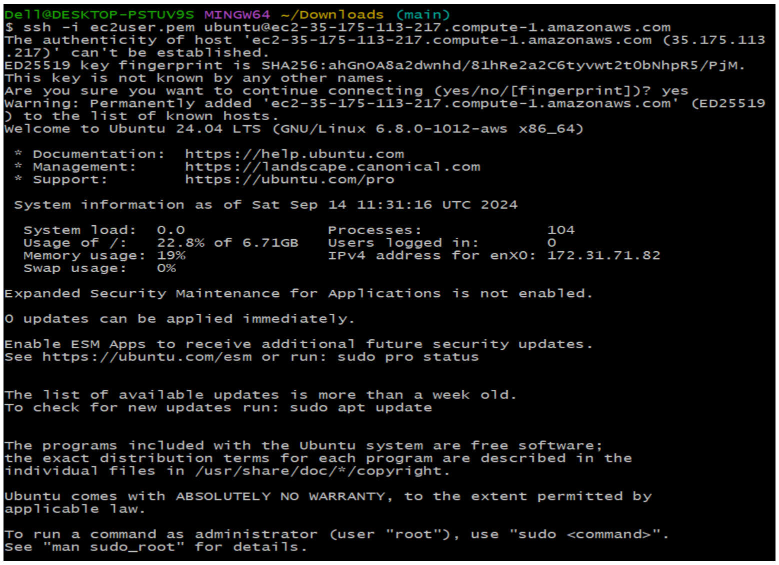


□	Name	Instance ID	Instance state	Instance type	Status check	Alarm status
□	Master	i-0589bc6d5e452907c	✓ Running	t2.medium	✓ 2/2 checks passec	View alarms +
□	Slave2	i-00856c9b137f44cf6	✓ Running	t2.medium	✓ 2/2 checks passec	View alarms +
□	Slave1	i-0beaf1d570ab06d73	✓ Running	t2.medium	✓ 2/2 checks passec	View alarms +

Step 2: Open git bash. Change your directory to Downloads and run chmod command on the key pair file that we created for all the EC2 instances that we launched in the earlier step. Hers, i have created a key pair with the name "ec2user" and gave it an extension .pem.
After assigning the key pair file the appropriate permissions, run the ssh command in the following format:
ssh -i <key pair.pem> ubuntu@<public ip address of the instance(DNS)>
Perform this command on all the 3 instances



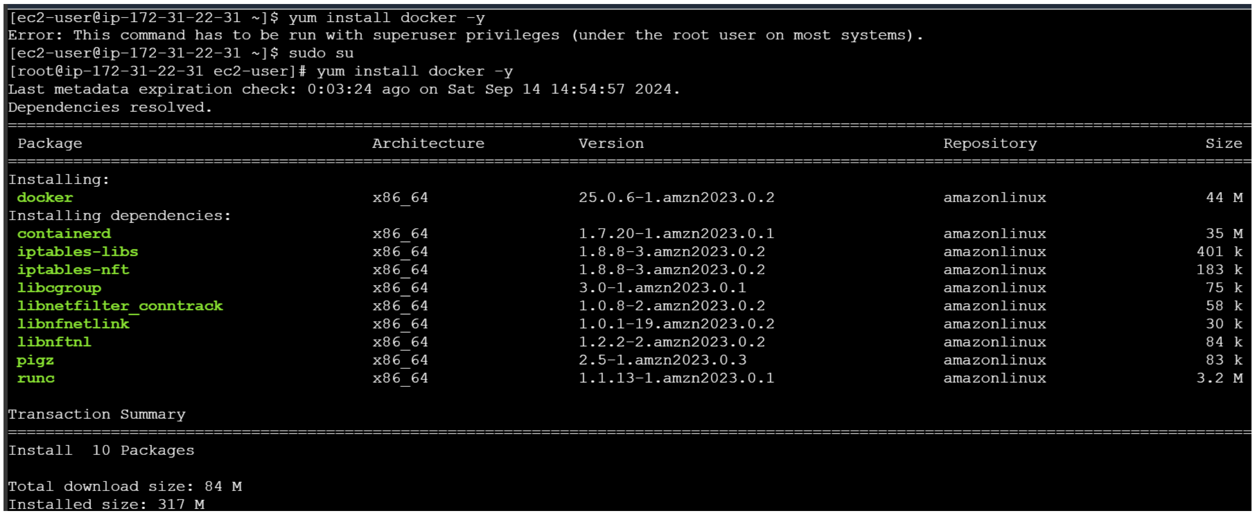
```
Dell@DESKTOP-PSTUV9S MINGW64 ~ (main)
$ cd Downloads

Dell@DESKTOP-PSTUV9S MINGW64 ~/Downloads (main)
$ chmod 400 "ec2user.pem"
```



```
Dell@DESKTOP-PSTUV9S MINGW64 ~/Downloads (main)
$ ssh -i ec2user.pem ubuntu@ec2-35-175-113-217.compute-1.amazonaws.com
The authenticity of host 'ec2-35-175-113-217.compute-1.amazonaws.com (35.175.113
.217)' can't be established.
ED25519 key fingerprint is SHA256:ahGnOA8a2dwnhd/81hRe2a2C6tyvwt2tObNhpR5/PjM.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'ec2-35-175-113-217.compute-1.amazonaws.com' (ED25519
) to the list of known hosts.
Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.8.0-1012-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Sat Sep 14 11:31:16 UTC 2024

  System load:  0.0               Processes:             104
  Usage of /:   22.8% of 6.71GB   Users logged in:       0
  Memory usage: 19%               IPv4 address for enX0: 172.31.71.82
  Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status


The list of available updates is more than a week old.
To check for new updates run: sudo apt update


The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
```

Step 3: Docker Installation

Perform this step on all 3 instances

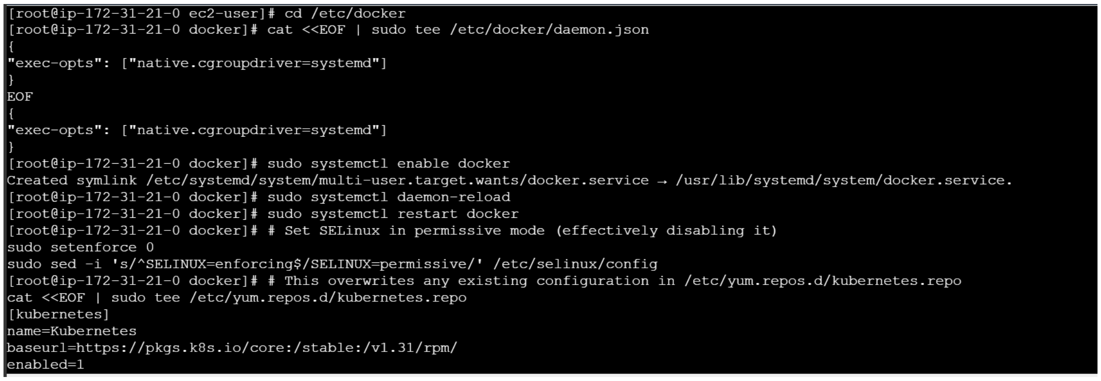


```
[ec2-user@ip-172-31-22-31 ~]$ yum install docker -y
Error: This command has to be run with superuser privileges (under the root user on most systems).
[ec2-user@ip-172-31-22-31 ~]$ sudo su
[root@ip-172-31-22-31 ec2-user]# yum install docker -y
Last metadata expiration check: 0:03:24 ago on Sat Sep 14 14:54:57 2024.
Dependencies resolved.
==========================================================================================================================
 Package                       Architecture          Version                             Repository                  Size
==========================================================================================================================
Installing:
 docker                        x86_64                25.0.6-1.amzn2023.0.2               amazonlinux                 44 M
Installing dependencies:
 containerd                    x86_64                1.7.20-1.amzn2023.0.1               amazonlinux                 35 M
 iptables-libs                 x86_64                1.8.8-3.amzn2023.0.2                amazonlinux                401 k
 iptables-nft                  x86_64                1.8.8-3.amzn2023.0.2                amazonlinux                183 k
 libcgroup                     x86_64                3.0-1.amzn2023.0.1                  amazonlinux                 75 k
 libnetfilter_conntrack        x86_64                1.0.8-2.amzn2023.0.2                amazonlinux                 58 k
 libnfnetlink                  x86_64                1.0.1-19.amzn2023.0.2               amazonlinux                 30 k
 libnftnl                      x86_64                1.2.2-2.amzn2023.0.2                amazonlinux                 84 k
 pigz                          x86_64                2.5-1.amzn2023.0.3                  amazonlinux                 83 k
 runc                          x86_64                1.1.13-1.amzn2023.0.1               amazonlinux                3.2 M

Transaction Summary
==========================================================================================================================
Install  10 Packages

Total download size: 84 M
Installed size: 317 M
```

Next, we are supposed to configure cgroup in a daemon.json file.

Run the following commands

```
cd /etc/docker
cat <<EOF | sudo tee /etc/docker/daemon.json
{
"exec-opts": ["native.cgroupdriver=systemd"],
"log-driver": "json-file",
"log-opts": {
"max-size": "100m"
},
"storage-driver": "overlay2"
}
EOF
sudo systemctl enable docker
sudo systemctl daemon-reload
sudo systemctl restart docker
```



```
[root@ip-172-31-21-0 ec2-user]# cd /etc/docker
[root@ip-172-31-21-0 docker]# cat <<EOF | sudo tee /etc/docker/daemon.json
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
EOF
{
"exec-opts": ["native.cgroupdriver=systemd"]
}
[root@ip-172-31-21-0 docker]# sudo systemctl enable docker
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service → /usr/lib/systemd/system/docker.service.
[root@ip-172-31-21-0 docker]# sudo systemctl daemon-reload
[root@ip-172-31-21-0 docker]# sudo systemctl restart docker
[root@ip-172-31-21-0 docker]# # Set SELinux in permissive mode (effectively disabling it)
sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
[root@ip-172-31-21-0 docker]# # This overwrites any existing configuration in /etc/yum.repos.d/kubernetes.repo
cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/
enabled=1
```

Step 4: Kubernetes Installation

Carry out this step on all 3 instances
Now, there are a number of steps to install kubernetes onto our instances

1. Set SELinux to permissive mode. These instructions are for Kubernetes 1.31.

```
# Set SELinux in permissive mode (effectively disabling it)
sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
```

2. Add the Kubernetes yum repository. The exclude parameter in the repository definition ensures that the packages related to Kubernetes are not upgraded upon running yum update as there's a special procedure that must be followed for upgrading Kubernetes. Please note that this repository have packages only for Kubernetes 1.31; for other Kubernetes minor versions, you need to change the Kubernetes minor version in the URL to match your desired minor version (you should also check that you are reading the documentation for the version of Kubernetes that you plan to install).

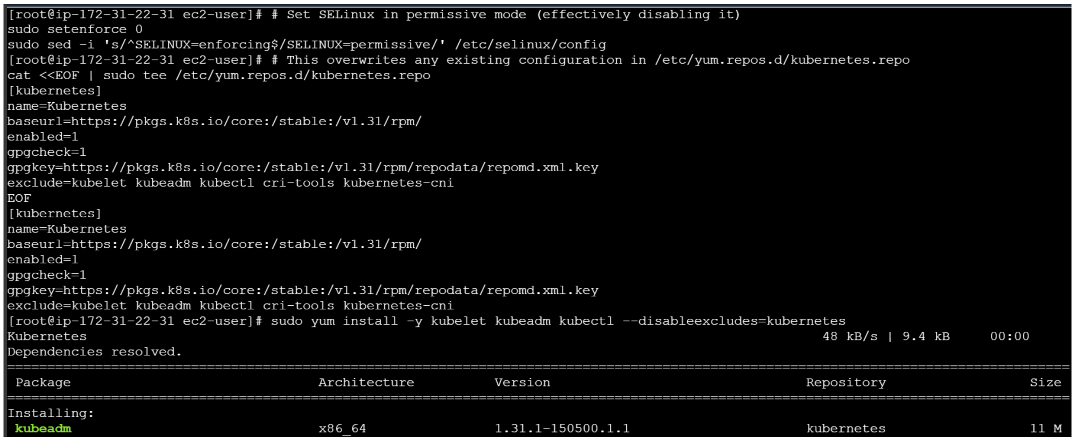
```
# This overwrites any existing configuration in /etc/yum.repos.d/kubernetes.repo
cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
EOF
```

3. Install kubelet, kubeadm and kubectl:

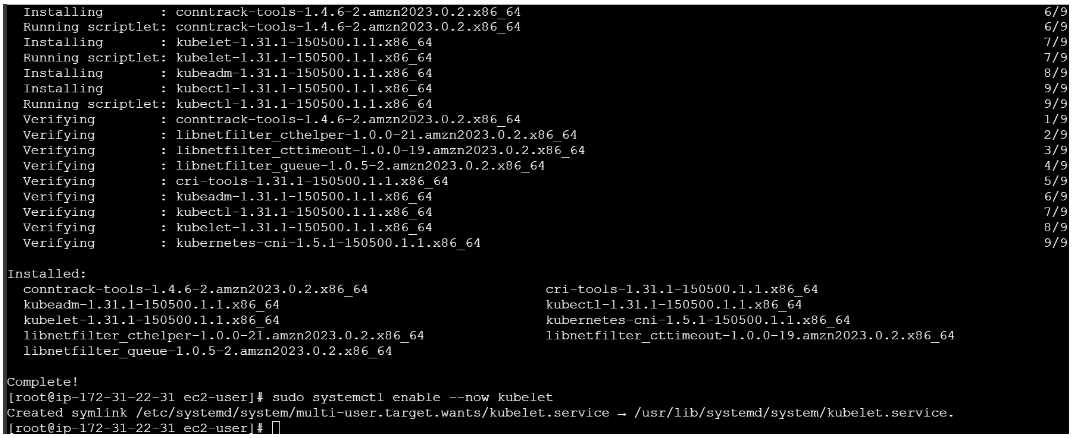
```
sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
```

4. (Optional) Enable the kubelet service before running kubeadm:

```
sudo systemctl enable --now kubelet
```



```
[root@ip-172-31-22-31 ec2-user]# # Set SELinux in permissive mode (effectively disabling it)
sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
[root@ip-172-31-22-31 ec2-user]# # This overwrites any existing configuration in /etc/yum.repos.d/kubernetes.repo
cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
EOF
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
[root@ip-172-31-22-31 ec2-user]# sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
Kubernetes                                                                          48 kB/s | 9.4 kB     00:00
Dependencies resolved.
=====================================================================================================================
 Package                          Architecture         Version                               Repository         Size
=====================================================================================================================
Installing:
 kubeadm                          x86_64               1.31.1-150500.1.1                     kubernetes         11 M
```



```
  Installing       : conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                                                        6/9
  Running scriptlet: conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                                                        6/9
  Installing       : kubelet-1.31.1-150500.1.1.x86_64                                                                   7/9
  Running scriptlet: kubelet-1.31.1-150500.1.1.x86_64                                                                   7/9
  Installing       : kubeadm-1.31.1-150500.1.1.x86_64                                                                   8/9
  Installing       : kubectl-1.31.1-150500.1.1.x86_64                                                                   9/9
  Running scriptlet: kubectl-1.31.1-150500.1.1.x86_64                                                                   9/9
  Verifying        : conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                                                        1/9
  Verifying        : libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64                                                 2/9
  Verifying        : libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64                                                3/9
  Verifying        : libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64                                                     4/9
  Verifying        : cri-tools-1.31.1-150500.1.1.x86_64                                                                 5/9
  Verifying        : kubeadm-1.31.1-150500.1.1.x86_64                                                                   6/9
  Verifying        : kubectl-1.31.1-150500.1.1.x86_64                                                                   7/9
  Verifying        : kubelet-1.31.1-150500.1.1.x86_64                                                                   8/9
  Verifying        : kubernetes-cni-1.5.1-150500.1.1.x86_64                                                             9/9

Installed:
  conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                       cri-tools-1.31.1-150500.1.1.x86_64
  kubeadm-1.31.1-150500.1.1.x86_64                                  kubectl-1.31.1-150500.1.1.x86_64
  kubelet-1.31.1-150500.1.1.x86_64                                  kubernetes-cni-1.5.1-150500.1.1.x86_64
  libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64                libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64
  libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64

Complete!
[root@ip-172-31-22-31 ec2-user]# sudo systemctl enable --now kubelet
Created symlink /etc/systemd/system/multi-user.target.wants/kubelet.service → /usr/lib/systemd/system/kubelet.service.
[root@ip-172-31-22-31 ec2-user]# 
```

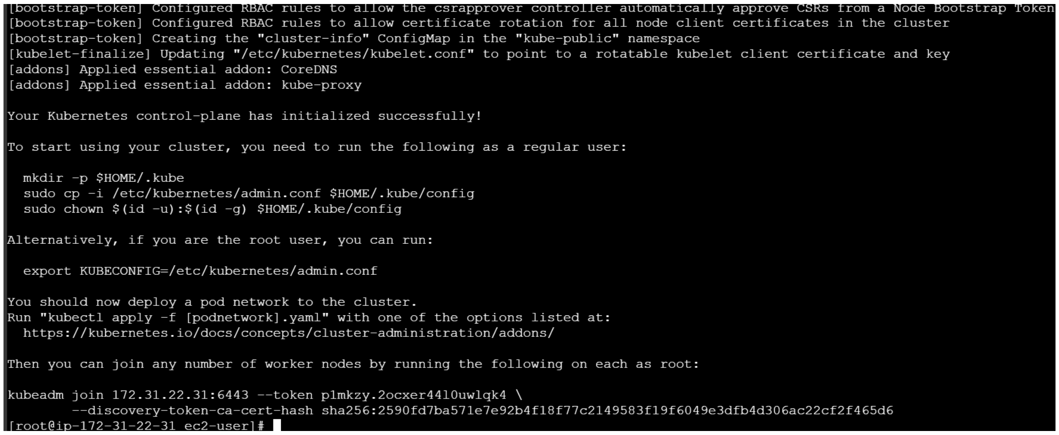
After installing Kubernetes,we need to configure internet options to allow bridging.

- Sudo swapoff-a
- echo"net.bridge.bridge-nf-call-iptables=1"|sudotee-a/etc/sysctl.conf
- Sudo sysctl-p

Step 5:

On master machine

Run command …kubeadm init with the proper network pod, here it is, --pod-network-cidr=10.244.0.0/16 to initialize kubernetes

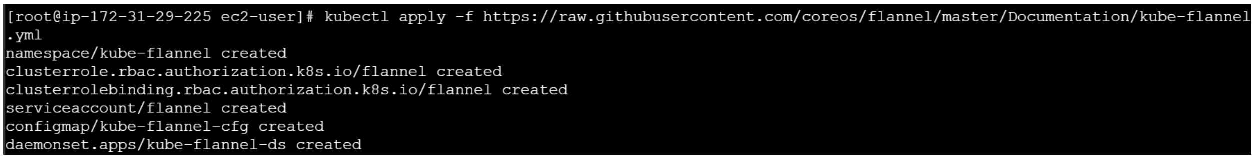


```
[bootstrap-token] Configured RBAC rules to allow the csrapprover controller automatically approve CSRs from a Node Bootstrap Token
[bootstrap-token] Configured RBAC rules to allow certificate rotation for all node client certificates in the cluster
[bootstrap-token] Creating the "cluster-info" ConfigMap in the "kube-public" namespace
[kubelet-finalize] Updating "/etc/kubernetes/kubelet.conf" to point to a rotatable kubelet client certificate and key
[addons] Applied essential addon: CoreDNS
[addons] Applied essential addon: kube-proxy

Your Kubernetes control-plane has initialized successfully!

To start using your cluster, you need to run the following as a regular user:

  mkdir -p $HOME/.kube
  sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
  sudo chown $(id -u):$(id -g) $HOME/.kube/config

Alternatively, if you are the root user, you can run:

  export KUBECONFIG=/etc/kubernetes/admin.conf

You should now deploy a pod network to the cluster.
Run "kubectl apply -f [podnetwork].yaml" with one of the options listed at:
  https://kubernetes.io/docs/concepts/cluster-administration/addons/

Then you can join any number of worker nodes by running the following on each as root:

kubeadm join 172.31.22.31:6443 --token plmkzy.2ocxer4410uwlqk4 \
        --discovery-token-ca-cert-hash sha256:2590fd7ba571e7e92b4f18f77c2149583f19f6049e3dfb4d306ac22cf2f465d6
[root@ip-172-31-22-31 ec2-user]# 
```

We are supposed to add a networking plugin named flaggen with the help of the command mentioned in the console output

i.e

kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml



```
[root@ip-172-31-29-225 ec2-user]# kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel
.yml
namespace/kube-flannel created
clusterrole.rbac.authorization.k8s.io/flannel created
clusterrolebinding.rbac.authorization.k8s.io/flannel created
serviceaccount/flannel created
configmap/kube-flannel-cfg created
daemonset.apps/kube-flannel-ds created
```

On worker machines

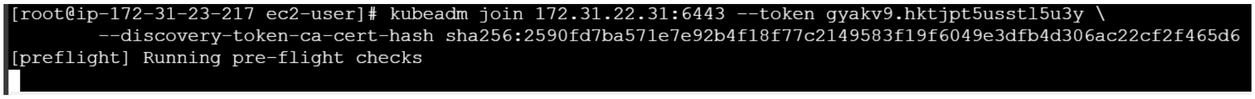
Run the following commands to ensure a smooth and secure joining to the master node

Paste the below command on all 2 worker machines

- sudo yum install iproute-tc-y
- sudo systemctl enable kubelet
- sudo systemctl restart kubelet

Then we are supposed to run the join command that was generated in the console output of our master machine

**kubeadm join 172.31.22.31:6443 --token gyakv9.hktjpt5usstl5u3y \
--discovery-token-ca-cert-hash sha256:2590fd7ba571e7e92b4f18f77c2149583f19f6049e3dfb4d306ac22cf2f465d6**



```
[root@ip-172-31-23-217 ec2-user]# kubeadm join 172.31.22.31:6443 --token gyakv9.hktjpt5usstl5u3y \
        --discovery-token-ca-cert-hash sha256:2590fd7ba571e7e92b4f18f77c2149583f19f6049e3dfb4d306ac22cf2f465d6
[preflight] Running pre-flight checks
```

Post which we are supposed to get the output that our worker nodes have been successfully connected to master node.

Unfortunately, on running the join command i was not able to produce anything beyond 'Running pre-flight checks' which can be seen in the above image

And thus, could not execute the last step of this experiment

Conclusion: In this experiment, we set up a connection between a local machine and an EC2 instance using SSH. After facing issues like timeouts and permission problems, we learned how to check for common causes such as incorrect security group settings, improper key permissions, and network issues. By resolving these, we successfully connected to the EC2 instance. This experiment helped us understand the steps required for remote server access and troubleshooting.